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"Strategic problems of agribusiness development and environmental burden in light of life cycle analysis in Hungary"

Bogone-Toth [a]*, Zs.-Lakner, Z. [b]

[a] *Department of Food Economics, Corvinus University Budapest, Hungary*

Abstract

Hungary, based on former Soviet Union market had had a relatively developed agro-food sector before the system –change up to the eighties of last century. In our days this system has collapsed, and the Hungarian agro-food complex can be characterised by extensive arable-crops production. There are numerous plans to develop the agriculture and food sector. The one emphasises the importance of energy –crop production. Another approach is based on intensive production, establishment of local food supply, and short food supply systems. Ecologic consequences of these strategies are analysed by life cycle approach, based on combined application of different open-source LCA software. Different solutions of packaging can we compare by OpenLCA software.

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1. Introduction

Hungary and its economy has undergone in a deep-rooted transition during the past quarter of century. The former, state owned, so –called socialist economy has been transformed into a free, market economic system.
This general, socio-economic transition has had important consequences on structure, conduct and performance of agro-food system. The state-owned agricultural and food industrial enterprises have been transformed into privately owned firms. The complex process of economic transition and privatisation has created a dual-type food economy structure. On one hand, there have been formed large –scale, concentrated enterprises mainly in multinational ownership, on another hand there are numerous, small-and medium size agricultural and food industrial production units. In most sectors there have been formed a relatively fragmented agro-food supply chain. This process has

* Corresponding author: Bogone-Toth. Tel.: 482-6254.
E-mail address: bogonetoth@uni-corvinus.hu

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created a contradiction: the food supply is polipolistic, and the food trade is highly concentrated.
As a consequence of this process, the food producers have and adverse bargaining position, are not able to achieve a considerable producer price increasing.

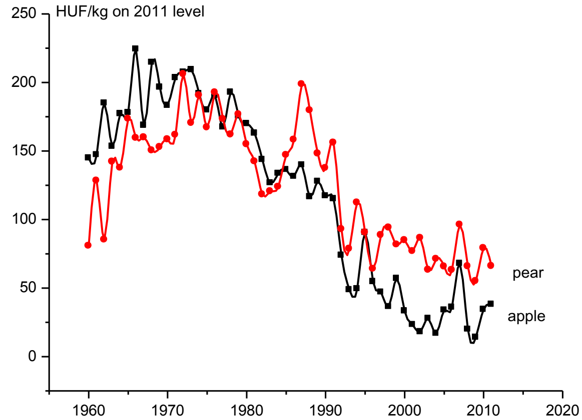

Figure 1. Producer's prices trends 1960-2011 in Hungary

E.g. the Figure 1. depicts the price dynamics of producer's prices of the two most important fruits in Hungary: the apple and pear in time interval 1960-2011, expressed in terms of 2011 value of the Hungarian national currency (Forint). This tendency can be generalised most of products in Hungarian agriculture. Under these conditions the producers are forced to increase the value added content of products. One of the most important ways to achieve this goal is the processing of products, e.g. production of different canned products of fruit juices. At the same time, this strategy helps to decrease the considerable volatility of prices.
On one hand, this is a favourable phenomenon, because motivates the innovation, on another hand this causes a considerable increasing of over-packaging of products. This considerably contributes to the increasing of environmental burden.

2. Methodology

To obtain a real picture on environmental effects of different packaging systems it is necessary to apply the approach of the life cycle analysis.
According to the data of Klöpffer (1997) the life cycle assessment (hereinafter: LCA) had been invented around 1970 at the Midwest Research Institute in the United States, and later on rapidly proliferated all over the developed countries. Originally, the basic focus of this methodology has been the comparative analysis of different packaging systems.
Today, in Hungary the life cycle analysis approach is rather under-developed, just some researchers, and a relatively small number of environmentally counscious enterprises try to apply this methodology.
In compliance with the criteria of the relevant ISO EN DIN standard, the basic criteria of life cycle assessment are as follows:
- the methods used in the conduction of this life cycle assessment are in line with this international standard
- the methods used in the conduction of this life cycle assessment have a scientific foundation and are feasible
- the data used are sufficient and suited in respect of the goal of the life cycle assessment
- the evaluation takes into account the restrictions recognised and the goal of the life cycle assessment
- the report is transparent and consistent.
Seager and Theis (2004) define six broad categories of metrics for testing the industrial ecology hypotheses:
(1) financial metrics, trying to monetarize each and every aspects of LCA components;
(2) thermodynamic metrics, converting the different in-and output aspects and components into thermodynamic

units,
(3) environmental metrics,
(4) ecological metrics, attempting to quantify the effects of production systems or services on the ecosystem functions;
(5) socio-political metrics, evaluating the different production systems in light of political and/or ethical goals of the society (E.g. in Hungary, where the political elite has an extremely high level of fear from energy-dependence from Russia, the energy-usage has a relatively high level of priority, even the social costs of alternative solutions are extremely high);
(6) aggregated metrics, trying to combine the different aspects of the above mentioned approaches.
In opinion of Matthews and Small (there are different LCA approaches):
(1) full, or exhaustive LCA,
(2) streamlined LCA and
(3) economic input –output LCA (EIO-LCA).
Difficult task of collecting relevant data in case of conventional LCA analysis. For example, to yield accurate results, the inventory of diesel oil use effects for a given production technology should reflect the local conditions of transportation of inputs: the ways and means of transportation, transportation distances, local mix of different fuels, applied for driving of transportation equipments. Getting such data is extremely difficult, because e.g. in different countries there are different geographical and technological solutions of long-range transportation. E:g. in case of Europe, the utilisation of inner waters for transportations shows considerable differences between the use of inner wateways.
The streamlined LCA approach offers a relatively simplified solution, excluding some down-and upside parts of the logistic supply chain. The EIO-LCA models are based on Leontief's input-output approach.
One of the most important aims of LCA is the analysis of waster emissions, generated by direct and indirect production processes. This is an extremely complex question in case of renewable and reusable materials, because in these processes the final outcome of analysis depends heavily on number of cycles. A classic example of this is the comparative analysis s of LCA of McDonalds' packaging systems: application of ground wood shells and polystyrene ones.
In opinion of Ayres (1995) the LCA methodology currently concerns evaluation methodology rather than data's. It is generally recognized, that different environmental impacts (chalk and cheese) cannot be legitimately compared." The comparative analysis of different packaging systems is typically a multidimensional problem. „

Some of the most important aspects of LCA are as follows:

- resource depletion;
- human toxicity;
- ecotoxicity;
- acidification;
- nitrification;

LCA has developed rapidly over the past three decades (Guinée et al., 2011). The development of the methodology started from a mere analysis of energy and environmental burdens of products, during the 1970´s, and currently is widely being used by researchers, organizations and tries (Garrigues et al., 2012). LCA seeks to quantify the use of natural resources, emissions, environmental impacts and health impacts associated with the products, processes and services (Welz, Hischer and Hilty, 2011).

3. Life Cycle Analysis

As a starting point, it should be highlighted, that there are numerous LCA software, which can be used in an efficient way to compare different alternatives of packaging of liquid foods.
From practical purposes it is highly important (and open-ended) question of the problems of transportation, because there are considerable differences in.
In case of recyclable packages the intensity of re-cycling is a highly problematic aspect. This question has been analysed in a detailed way in work of Golding, 1998. In his report the author has detected three totally different approaches towards the re-use strategies at that-time Europe: In some countries, like the UK., France and Ireland the

reuse systems had almost disappeared and cover lower than 5% of the market. In some other countries, mainly in Mediterranean ones, the reuse systems remained operating just in some branches, e.g. carbonised beverages and wine. In Nordic countries (e.g. Finland, Germany, Sweden), where reuse systems had been working with a high level of efficiency.

The considerable national differences have remained in our days: according to the latest data of European Aluminium Association the recycling rate for aluminium beverage can in 2010 has been extremely high in Nordic countries (Germany 96%, Finland 95%, Norway: 93%, Denmark 89%, Sweden: 87%), and relatively low in Mediterranean region (Spain: 61%, Malta: 59%, France 57%, Hungary 50%, Portugal: 45%, Greece: 38%). The relatively new member states of the EU can be characterised by low recycling values, too (Romania 20%).

At the same time, based on a comprehensive analysis of literature, Roy et al. (2009) conclude, that LCA methodologies are extremely useful to get a realistic picture on environmental impacts of a food production system. An important aspect of e

Life cycle analysis has been developed for this purpose. The most important characteristic features of this methodology are as follows:

1. System-based approach- the application of food packaging is extremely complex, because there are different economic actors: packaging material producers, food processors, recyclers-but the life cycle analysis analyses all of these processes as a single system.

2. From cradle to grave- this refers a holistic assessment from raw-material production, to manufacture, distribution, use and disposal including all intervening transportation steps necessary or caused by the product's existence.

3. Glass –box approach-we analyse each of processes in detail.

4. From this follows, that there is a high demand for reliable data on ecologic consequences of different technological solutions.

There are numerous software for LCA analysis. Most of these are commercial products. In our research we have applied the OpenLCA developed by support of the European Union? The open LCA is a free, professional Life Cycle Assessment (LCA) and Footprint software with a broad range of features and many available databases, created by Green Delta since 2006. It is open source software; the software and its source code is freely available.

We have applied this software for analysis of alu-can recycling.

Our first test was modelling of the alu can process from raw aluminium.

Why the alu can?

The demand for aluminium products is growing steadily because of their positive contribution to modern living. Aluminium is the second most widely used metal whereas the aluminum can is the most recycled consumer product in the world. Aluminium finds extensive use in packaging: beer, soft and energy drinks, canned fruit and vegetables. The excellent recyclability of aluminium, together with its high scrap value and low energy needs during recycling make aluminium highly desirable to one and all.

Aluminium does not degrade during the recycling process, since its atomic structure is not altered during melting. Aluminium recycling is both economically and environmentally effective, as recycled aluminium requires only 5% of the energy used to make primary aluminium, and can have the same properties as the parent metal. Intact, aluminium can be recycled endlessly without loss of material properties.

Recycling of Aluminium Cans

Aluminium can is the most recycled consumer product in the world. Each year, the aluminium industry pays out more than US$800 million for empty aluminium cans. Recycling aluminium cans is a closed-loop process since used beverage cans that are recycled are primarily used to make beverage cans. Recycled aluminium cans are used again for the production of new cans or for the production of other valuable aluminium products such as engine blocks, building facades or bicycles. In Europe about 50% of all semi-fabricated aluminium used for the production of new beverage cans and other aluminium packaging products comes from recycled aluminium.

Recycled aluminium production (refining and remelt) in Europe reached around 4.3 million tonnes in 2010, 2.2 millions of which produced by refiners. Worldwide, aluminium refiners produced some 7.7 million tonnes.

4. Results and discussion

The software processes can be modelled and calculated in the energy use and the environmental load data values.

This figure depicts the aluminium assembly line, which uses aluminium plate as input for alu can production. The by-products of alu-can production as waste are taken into consideration, too, as input of alu can production. In line with system-based approach we have calculated the environmental burden of aluminium production form aluminium ore . In a modern society one (preferably high) part of used alu-cans are recycled, that's why we have taken into account the recycling, as an input of further processing. The aluminium assembly line is a highly complex process, demanding numerous inputs, among other things energy. In this graph we show one small part of electrical energy supply, as an example. Of course, the original model contains the energy demand for transportation of primer energy sources to the power plant, too.

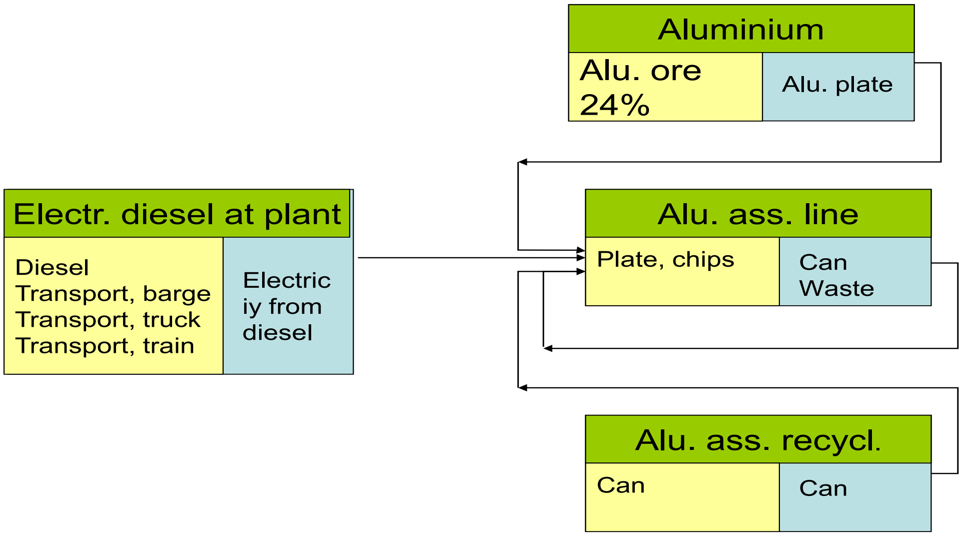

Figure 2. Simplified process for aluminum cans production

5. Conclusions

As a summary, it can be stated, that the LCA is a highly complex process, but the latest methods of decision support systems make it relative easy to use. It offers a favourable possibility for

Compiling an inventory of relevant energy and material inputs and environmental releases;

Evaluating the potential impacts associated with identified inputs and releases;

Interpreting the results to help make a more informed decision on different economic measures to motivate the different economic entities (enterprises and citizens) for more sustainable behaviour.

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